CLAIMS

1. A fluorescent lamp lighting apparatus comprising:

a DC-voltage generation circuit for generating a DC voltage,

a drive-signal generation circuit for generating and outputting desired high-voltage-side and low-voltage-side pulse signals by using the DC voltage from said DC-voltage generation circuit, and

a drive control circuit having switching means driven by the pulse signals input from said drive-signal generation circuit to output a drive signal across the output terminals thereof, wherein a resonance circuit and the filament electrodes of a fluorescent lamp light-emitting tube are connected across the output terminals of said switching means.

2. A fluorescent lamp lighting apparatus comprising:

a DC-voltage generation circuit for generating a DC voltage,

a drive-signal generation circuit for generating and outputting desired high-voltage-side and low-voltage-side pulse signals by using the DC voltage from said DC-voltage generation circuit, and

a drive control circuit having first switching means driven by the high-voltage-side pulse signal input from said drive-signal generation circuit, and second switching

means connected in series therewith and driven by the low-voltage-side pulse signal input from said drive-signal generation circuit, wherein an inductance device, the pair of filament electrodes of the fluorescent lamp light-emitting tube and a first capacitor are connected across both ends of said second switching means.

3. A fluorescent lamp lighting apparatus in accordance with claim 1 or 2, wherein said drive-signal generation circuit comprises:

a timer circuit in which the output signal thereof is altered after a predetermined time from power on,

a separate-excitation oscillator for outputting a signal having a predetermined frequency,

a separate-excitation/self-excitation selection switch circuit for outputting one of two input signals depending on the output signal of said timer circuit,

a trigger input circuit for detecting the resonance frequency of said series resonance circuit,

a high-voltage-side pulse generation circuit having a high-voltage-side dead time generation circuit, a narrow pulse generation circuit, a level shift circuit, a pulse reproduction circuit and an output circuit,

a low-voltage-side pulse generation circuit having a low-voltage-side dead time generation circuit and an output circuit, and

an under-voltage lockout circuit for outputting an

output signal when the voltage of the power source is a predetermined voltage or less at the time of the rising and falling of the power source.

54. A fluorescent lamp lighting apparatus in accordance with claim 2, wherein said first and second switching means are each configured by a MOS transistor that outputs a power-amplified signal across the source and the drain by using a signal supplied to the gate.

35. A fluorescent lamp lighting apparatus in accordance with claim 1 or 2, wherein

said drive-signal generation circuit has an under-voltage lockout circuit for outputting an output signal when the voltage of the power source is a predetermined voltage or less at the time of the rising and falling of the power source,

the output of said separate-excitation oscillator and the output of said trigger input circuit are connected to said separate-excitation/self-excitation selection switch circuit, said separate-excitation/self-excitation selection switch circuit outputs the output signal from said separate-excitation oscillator in a state before the output signal of said timer circuit is switched, and outputs the output signal of said trigger input circuit in a state after the output signal of said timer circuit is switched,

the output of said separate-excitation/self-excitation selection switch circuit is input to said high-voltage-side pulse generation circuit and said low-voltage-

side pulse generation circuit, respectively, to drive said first and second switching means, thereby to oscillate said drive control circuit, and

said separate-excitation oscillator and said timer circuit are reset by the output signal of said under-voltage lockout circuit at the time of the rising and falling of the power source.

6. A fluorescent lamp lighting apparatus in accordance with claim 2, further comprising a timer circuit configured so that a capacitor, one terminal of which is grounded, is charged with a constant current at the rising of the power source, and so that when the voltage across the terminals of said capacitor reaches a setting voltage, the output signal is switched.

7. A fluorescent lamp lighting apparatus in accordance with claim 2, further comprising a timer circuit configured so that the period from power on to the switching of the output signal is shortened as the ambient temperature rises, and extended as the ambient temperature lowers.

8. A fluorescent lamp lighting apparatus in accordance with claim 2, wherein said separate-excitation oscillator is configured to output a signal wherein the frequency of the output signal is gradually changed from either the low-frequency range or the high-frequency range of the resonance frequency of the LC resonance circuit at the time of non-lighting of said light-emitting tube.

9. A fluorescent lamp lighting apparatus in accordance with claim 2, wherein said trigger input circuit has a comparator and at least three diodes, the reference voltage (threshold voltage) with respect to the input signal of said comparator is set so that the voltage of the input signal at the time of rising is higher than the voltage at the time of falling, the cathode of the first diode is connected to the anode of the second diode, the cathode of the second diode is connected to the anode of the third diode, and the anode of the first diode is connected to the cathode of the third diode.

10. A fluorescent lamp lighting apparatus in accordance with claim 2, wherein said drive-signal generation circuit has a low-voltage-side under-voltage lockout circuit and a high-voltage-side under-voltage lockout circuit, and is configured so that said low-voltage-side under-voltage lockout circuit operates earlier than said high-voltage-side under-voltage lockout circuit at the time of power off.

11. A fluorescent lamp lighting apparatus in accordance with claim 2, further comprising a timer circuit configured so that a capacitor, one terminal of which is grounded, is charged with a constant current at the rising of the power source, and so that when the voltage across the terminals of said capacitor reaches a setting voltage, the output signal is switched, wherein

said separate-excitation oscillator is configured to output a signal for changing the frequency of lighting from

a frequency higher than the resonance frequency of said LC resonance circuit at the time of non-lighting of said light-emitting tube to a frequency lower than said resonance frequency depending on the voltage across the terminals of the capacitor of said timer circuit.

12. A fluorescent lamp lighting apparatus in accordance with claim 2, further comprising a timer circuit configured so that a capacitor, one terminal of which is grounded, is charged with a constant current at the rising of the power source, and so that when the voltage across the terminals of said capacitor reaches a setting voltage, the output signal is switched, wherein

a resistor is inserted between one terminal of said capacitor, the other terminal of which is grounded, and the power source, or between one terminal of said capacitor, the other terminal of which is grounded, and ground, said separate-excitation oscillator is configured to output a signal for changing the frequency of lighting from a frequency higher than the resonance frequency of said LC resonance circuit at the time of non-lighting of said light-emitting tube to a frequency lower than said resonance frequency.

13. A fluorescent lamp lighting apparatus in accordance with claim 2, further comprising a timer circuit configured so that a capacitor, one terminal of which is grounded, is charged with a constant current at the rising of the power source, and so that when the voltage across the terminals of

said capacitor reaches a setting voltage, the output signal is switched, wherein said timer circuit is configured so that the switching time is extended as the temperature lowers.

13. A fluorescent lamp lighting apparatus in accordance with claim 2, further comprising a timer circuit configured so that a capacitor, one terminal of which is grounded, is charged with a constant current at the rising of the power source, and so that when the voltage across the terminals of said capacitor reaches a setting voltage, the output signal is switched, wherein a diode is connected in series with a circuit for determining the setting voltage in said timer circuit, and said timer circuit is configured so that the switching time is extended as the temperature lowers because of the temperature dependence characteristic of the resistance value of the diode.

15. A fluorescent lamp lighting apparatus in accordance with claim 2, further comprising a timer circuit configured so that a capacitor, one terminal of which is grounded, is charged with a constant current at the rising of the power source, and so that when the voltage across the terminals of said capacitor reaches a setting voltage, the output signal is switched, wherein said separate-excitation oscillator is configured to output a signal having a frequency gradually decreasing from a frequency higher than the resonance frequency of said LC resonance circuit at the time of non-lighting of said light-emitting tube, and then to output a signal having the resonance frequency of said LC resonance circuit at the time

of lighting of said light-emitting tube.

21 16. A fluorescent lamp lighting apparatus in accordance with claim 2, further comprising a timer circuit configured so that a capacitor, one terminal of which is grounded, is charged with a constant current at the rising of the power source, and so that when the voltage across the terminals of said capacitor reaches a setting voltage, the output signal is switched, wherein said separate-excitation oscillator is configured so that the duty ratio of the output frequency is switched by the signal from said timer circuit.

14 17. A fluorescent lamp lighting apparatus in accordance with claim 2, further comprising a timer circuit configured so that a capacitor, one terminal of which is grounded, is charged with a constant current at the rising of the power source, and so that when the voltage across the terminals of said capacitor reaches a setting voltage, the output signal is switched, wherein said separate-excitation oscillator is configured so that the duty ratio of the output frequency is switched by the signal from said timer circuit to set the preheating state and the lighting state of the filaments of said light-emitting tube.

15 18. A fluorescent lamp lighting apparatus in accordance with claim 2, further comprising a timer circuit configured so that a capacitor, one terminal of which is grounded, is charged with a constant current at the rising of the power source, and so that when the voltage across the terminals of

said capacitor reaches a setting voltage, the output signal is switched, wherein a delay circuit is connected to the output of said trigger input circuit or the output of said separate-excitation/self-excitation selection switch circuit, and the amount of delay increases after the output signal of said timer circuit exceeds the reference voltage for switching.

19. A fluorescent lamp lighting apparatus in accordance with claim 2, further comprising a timer circuit configured so that a capacitor, one terminal of which is grounded, is charged with a constant current at the rising of the power source, and so that when the voltage across the terminals of said capacitor reaches a setting voltage, the output signal is switched, wherein said separate-excitation oscillator is configured to stop oscillation after the output signal of said timer circuit is switched.

20. A fluorescent lamp lighting apparatus in accordance with claim 9, wherein the output of said trigger input circuit is canceled after the input signal exceeds the reference voltage (threshold voltage) of said comparator, and even when the input signal exceeds the reference voltage with respect to the input of said comparator again in a period having been set shorter than the half period of the resonance frequency of said resonance circuit.

21. A fluorescent lamp lighting apparatus in accordance with claim 9, wherein a capacitor for delaying the input signal of said comparator is connected to the input portion

of said comparator to attain phase alignment at the time of detecting the resonance frequency of said LC resonance circuit.

22. A fluorescent lamp lighting apparatus in accordance with claim 1 or 2, wherein said drive-signal generation circuit comprises:

a timer circuit in which the output signal thereof is switched at a predetermined time after power on,

a separate-excitation oscillator for outputting a signal having a predetermined frequency,

a separate-excitation/self-excitation selection switch circuit for outputting one of two input signals depending on the output signal of said timer circuit 212,

a trigger input circuit for detecting the resonance frequency of said series resonance circuit,

a high-voltage-side pulse generation circuit having a high-voltage-side dead time generation circuit, a narrow pulse generation circuit, a level shift circuit, a pulse reproduction circuit and an output circuit,

an under-voltage-side pulse generation circuit having an under-voltage side dead time generation circuit and an output circuit,

an under-voltage lockout circuit for outputting an output signal when the voltage of the power source is a predetermined voltage or less at the time of the rising and falling of the power source, and

a delay circuit connected to the output of said

trigger input circuit or the output of said separate-excitation/self-excitation selection switch circuit so that the amount of delay can be controlled depending on an external input voltage.

23. A fluorescent lamp lighting apparatus in accordance with claim 15, wherein the frequency of said separate-excitation oscillator is controlled after the lighting of said light-emitting tube.

24. A fluorescent lamp lighting apparatus in accordance with claim 15 or 16, wherein the output duty of said separate-excitation oscillator is controlled after the lighting of said light-emitting tube.

25. A fluorescent lamp lighting apparatus comprising a light-emitting portion having a light-emitting tube excited by a pair of filament electrodes and a power source circuit portion for outputting a signal for driving said pair of filament electrodes, wherein

said power source circuit portion comprises:

a DC-voltage generation circuit for outputting a smoothened DC voltage from an externally supplied AC power source,

a drive-signal generation circuit operated by the application of the DC voltage of said DC-voltage generation circuit to output a signal, and

a drive control circuit, having a resonance circuit network connected across the terminals for outputting a signal

driven by the signal from said drive-signal generation circuit, for detecting the signal of this resonance circuit network and outputting the signal to a signal detection terminal, wherein

said drive-signal generation circuit is configured to output a signal having a frequency, which is determined inside said drive-signal generation circuit, changes with the passage of time, and at least passes through the resonance frequency of said resonance circuit network in the non-lighting state of said light-emitting tube within a predetermined time from the application of said DC voltage, and to output a signal having the phase corresponding to the signal of said signal detection terminal after said predetermined time has passed.

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26. A fluorescent lamp lighting apparatus comprising a light-emitting portion having a light-emitting tube excited by a pair of filament electrodes and a power source circuit portion for outputting a signal for driving said pair of filament electrodes, wherein

said power source circuit portion comprises:

a DC-voltage generation circuit for outputting a smoothened DC voltage from an externally supplied AC power source,

a drive-signal generation circuit operated by the application of said DC voltage to output first and second drive signals individually,

first switching means wherein the conduction between two terminals, that is, between one terminal and one

of the pair of output terminals of said DC-voltage generation circuit, is turned on and off by said first drive signal,

second switching means wherein the conduction between two terminals, that is, between one terminal and the other of the pair of output terminals of said DC-voltage generation circuit, is turned on and off by said second drive signal, and

a resonance circuit network connected between the common connection portion of said first and second switching means and at least one of the pair of output terminals of said DC-voltage generation circuit, wherein

said first and second drive signals are each configured to output a signal having a frequency, which is determined inside said drive-signal generation circuit, changes with the passage of time, and at least passes through the resonance frequency of said resonance circuit network in the non-lighting state of said light-emitting tube within a predetermined time from the application of said DC voltage, and to output a signal having the phase corresponding to the signal of said signal detection terminal after said predetermined time has passed.

~~21~~ 20. A fluorescent lamp lighting apparatus in accordance with claim ~~26~~ 25, wherein said drive-signal generation circuit comprises:

a trigger input circuit for taking and converting the signal of said resonance circuit network into a pulse signal,

a separate-excitation oscillator for outputting an oscillation signal having a frequency changing with the passage of time after the application of said DC voltage and at least passing through the resonance frequency of said resonance circuit network in the non-lighting state of said light-emitting tube,

a timer circuit for switching the output state of the output terminal at a constant time after the application of said DC voltage,

a separate-excitation/self-excitation selection switch for inputting the output signal of said separate-excitation oscillator and the output signal of said trigger input circuit and outputting one of the two input signals depending on the signal at the output terminal of said timer circuit,

a first drive-signal generation circuit for generating and outputting a first drive signal from the output signal of said separate-excitation/self-excitation selection switch, and

a second drive-signal generation circuit for inputting the output signal of said separate-excitation/self-excitation selection switch and for generating and outputting a second drive signal.

28. A fluorescent lamp lighting apparatus in accordance with claim 24, wherein said first drive-signal generation circuit comprises:

a high-voltage-side dead time generation circuit for inputting the output signal of said separate-excitation/self-excitation selection switch, and in synchronization with one edge of this signal, for outputting a signal delayed by a predetermined value, and

a high-voltage-side pulse generation circuit for inputting the output signal of said high-voltage-side dead time generation circuit, and for outputting a pulse signal in response to an edge of this input signal and on the basis of the voltage applied to the common connection portion of said first and second switching means, and wherein

said second drive-signal generation circuit comprises:

a low-voltage-side dead time generation circuit for inputting the output signal of said separate-excitation/self-excitation selection switch, and in synchronization with the other edge of this signal, for outputting a signal delayed by said predetermined value, and

a low-voltage-side pulse generation circuit for inputting the output signal of said low-voltage-side dead time generation circuit, and for outputting a pulse signal in response to an edge of this input signal and on the basis of the low-voltage-side voltage of said DC-voltage generation circuit.

29. A fluorescent lamp lighting apparatus in accordance with claim 28, wherein

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said high-voltage-side pulse generation circuit comprises:

a narrow pulse generation circuit for inputting the output signal of said high-voltage-side dead time generation circuit, and for outputting a pulse signal having a relatively narrow width in response to an edge of this input signal,

a level shift circuit for inputting the output signal of said narrow pulse generation circuit and for outputting a signal having a different peak value,

a high-voltage-side pulse reproduction circuit for inputting the output signal of said level shift circuit and for outputting a pulse signal on the basis of the voltage at the common connection portion of said first and second switching means, and

a high-voltage-side output circuit for inputting the output signal of said high-voltage-side pulse reproduction circuit and for outputting a drive signal on the basis of the voltage at the common connection portion of said first and second switching means.